We claim:

1. A method of applying a thin film coating to a substrate, comprising the steps of:

(a) mounting a substrate to be coated on a substrate holder in an evacuatable chamber and so that said substrate is spacedly juxtaposed with a crucible containing a component of a coating to be applied to said substrate;

(b) evacuating said chamber;

(c) positioning a shutter between said crucible and said substrate and heating said component in said crucible with a high energy beam;

(d) admitting a gas mixture to said chamber containing at least one gas reactive with said component to form said coating;

(e) connecting said substrate holder to a radio frequency or pulsed direct current source so that said substrate holder is poled cathodic and a plasma is formed at least around said substrate to create a self bias of several hundreds of volts on said substrate holder and a surface of said substrate is bombarded with particles from the plasma;

(f) withdrawing said shutter from its position between said crucible and said substrate, bombarding said component with low energy electrons to ionize said component at least in part

and depositing a reaction product of said component and said at least one gas on said substrate; and

(g) controlling the ionization of said component so that said self bias is reduced by at least 50%.

2. The method defined in claim 1 wherein said self bias and said plasma are produced by connecting said substrate holder to a radio frequency source.

3. The method defined in claim 2 wherein the deposition of said coating is monitored and the coating is terminated when a predetermined thickness of the coating is reached.

4. The method defined in claim 1 wherein said thin film coating is an optical coating.

5. The method defined in claim 1, further comprising the step of depositing a reaction product of a component from another crucible and said at least one gas on said substrate following the deposition of said coating thereon.

6. The method defined in claim 1 wherein said component is heated in said crucible with a high energy electron beam from an electron beam gun.

7. The method defined in claim 6, further comprising the step of directing another electron beam from a further electron beam gun onto said component in said crucible.

8. An apparatus for applying a thin film coating to a substrate comprising:

a vacuum chamber connectable to a pump adapted to evacuate said chamber;

at least one crucible in said chamber;

a substrate holder in said chamber receiving a substrate to be coated and juxtaposed with said crucible;

a mechanical shutter in said chamber interposable between said crucible and said substrate;

a high-energy source for heating a component of a coating to be deposited upon said substrate in said crucible;

a radio frequency or pulsed direct current source connectable to said substrate holder for producing a plasma around said substrate and imparting a self-bias to said substrate holder poling said substrate holder cathodic;

means for feeding a gas mixture to said chamber including at least one gas reactive with said component to form a coating on said substrate; and

a low energy electron source for ionizing said component to reduce said self-bias and deposit a reaction product of said component and said at least one gas on said substrate, said shutter being movable from one said crucible and said substrate to permit ionization of said component.

9. The apparatus defined in claim 8 wherein said substrate holder is mounted for rotation in said chamber.

10. The apparatus defined in claim 9 wherein said chamber is formed with an insulated feed-through for connecting said source to said substrate holder.

11. The apparatus defined in claim 10, further comprising an instrument for measuring the thickness of said coating on said substrate for controlling the deposition of said reaction product on said substrate.

12. The apparatus defined in claim 11 wherein said crucible is electrically heated.

13. The apparatus defined in claim 11 wherein said component is heated in said crucible by sputtering.

14. The apparatus defined in claim 11 wherein said source is a radio frequency source.

15. The apparatus defined in claim 11 wherein said crucible is rotatable in said chamber.

16. The apparatus defined in claim 11, further comprising another crucible containing a respective component capable of forming a reaction product which can be deposited on said coating.

17. The apparatus defined in claim 11 wherein said component is heated in part by an electron beam gun.

18. The apparatus defined in claim 17, further comprising another electron beam gun in said chamber for heating said component.

19. A method of applying a thin film coating to a substrate, comprising the steps of:

(a) mounting a substrate to be coated on a substrate holder in an evacuatable chamber and so that said substrate is spacedly juxtaposed with a crucible containing a component of a coating to be applied to said substrate;

(b) evacuating said chamber;

(c) positioning a shutter between said crucible and said substrate and heating said component in said crucible with a high energy beam;

(d) admitting a gas mixture to said chamber;

(e) connecting said substrate holder to a radio frequency or pulsed direct current source so that said substrate holder is poled cathodic and a plasma is formed at least around said substrate to create a self bias of several hundreds of volts on said substrate holder and a surface of said substrate is bombarded with particles from the plasma;

(f) withdrawing said shutter from its position between said crucible and said substrate, bombarding said component with low energy electrons to ionize said component at least in part and depositing said component and said at least one gas on said substrate; and

(g) controlling the ionization of said component so that said self bias is reduced by at least 50%.